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marsh and the sand dune. The composition of the various associations and the trend of succession are like those of the Continent and are familiar through the work of WARMING, MASSART, and other writers. Perhaps the most unique feature of the British coast is afforded by the shingle beach communities, which are most ably treated by OLIVER, who conducted the 1911 party to his seaside laboratory at Blakeney, where these communities are well developed. The most striking feature here is the presence of a shingle or gravel dune, which invades the marshland and presents conditions resembling in many ways the more familiar phenomena of sand dunes.

The photographic illustrations in this volume are notably well selected, and most admirably reproduced, and are supplemented by a few instructive diagrams. The British vegetation committee may well be proud of their record for 1911. It is to be hoped and expected that such books as the one here reviewed, and such phytogeographic excursions as the one here mentioned, will hereafter be frequently recurring features of phytogeographic progress.—H. C. COWLES.

The soil solution

Those plant physiologists who are interested in the subterranean surroundings of plants and in the relations which obtain between soil conditions and plant activity will welcome CAMERON's little book entitled *The soil solution*.³ The treatment is exceedingly clear and concise, logically arranged, and very readable. Furthermore, it is unquestionably the best and most scientific treatise on this difficult yet most important subject which we have seen. The author originally approached the soil problems from the standpoint of the chemist, developing their biological and agricultural aspect according to the demands of researches under his direction, and perhaps this fact has left a mark upon some of his discussions which may seem novel to the reader coming to this field from a specifically botanical training. But the novel features of the author's treatment may be regarded as quite in line with the recent trend of physiology toward a quite uncolored physical treatment.

Another group of workers whose attitude toward plant happenings is often not that of the physiologist, and whose activities have been mainly directed toward the empirical acquisition of more or less superficial principles and relations, will read CAMERON's contribution with much interest, perhaps even with excitement. We refer here to students of practical agriculture, who will find here that some of the most widely accepted hypotheses of this field are clearly discredited. This will not be at all surprising, however, to him who has followed the recent literature, for the previous publications of the author and his colleagues have given, from time to time, the main features of the researches upon which his present attitude toward soil science has been built up. During

³ CAMERON, FRANK K., *The soil solution, the nutrient medium for plant growth*. pp. v+136. figs. 3. Easton (Pa.): The Chemical Publishing Co. 1911.

the past decade we have received many quite novel propositions and suggestions from this group of workers, most of which were read with greater or less lack of conviction by agricultural scientists. With the advance of time, however, most of these new ideas have continually gained ground throughout the world.

Aside from its general value as an example of an exceptionally rational study of a very complex and difficult set of natural relations, the keynote of the present book is perhaps suitably expressed by the following sentence taken from p. 17: "Just as the phlogiston theory passed away when the elementary nature of oxygen was established and LAVOISIER taught the scientific world to use the balance, so the plant food theory of fertilizers must pass with increasing knowledge of the relation of soil to plant and the application of modern methods of research to the problem."

It is emphasized throughout that the problems here involved are dynamic; that the soil, as well as the plant, are the seats of continuously changing chemical and physical processes; thus no static interpretation of the environment of roots is of much avail, and the general failure of soil analyses to answer the fundamental question with which we are concerned seems to have been due to the failure of such methods to bring out the dynamic nature of soil phenomena. A chapter is devoted to a somewhat thorough discussion of the concentration and the nature of the mineral solutes of the soil solution, with reference to the conditions which control these features and keep them in constant change, always tending toward equilibrium but probably seldom attaining it. Then follows a discussion of soil absorption, with a clear setting forth of the logical fallacy of the prevalent interpretation of apparent soil acidity.

In the chapter on "The balance between supply and removal of mineral plant nutrients," MCGEE's startling series of terms ("run-off," "cut-off," "fly-off") to denote the superficial and subterranean drainage and the loss by evaporation, respectively, from the soil has been adopted. The reviewer can see so little tendency of modern serious English to revert to this fundamentally Teutonic style of etymology that he cannot but look askance at these last two newly coined expressions. This chapter is the weakest in the book, and most readers will feel that the question "Is the movement of mineral plant nutrients toward the surface soil equal to or in excess of the removal by drainage waters and garnered crops?" (p. 75) is not answered with data or considerations which even "appear sufficient for the present purpose." The approximations given of the number of tons of potassium, etc., annually carried, in the United States, toward the soil surface, removed by crops, and washed into the sea are of no interest as regards any particular plant or soil. The question must be settled with reference to particular soil areas, by experimental studies yet to be accomplished. However, the author is quite aware of the weakness of these calculations, and admits that "it is wise to avoid giving them too much emphasis." His thesis against the LIEBIG theory of fertilizer action gets its support from quite different lines of argument.

In the chapter on "The organic constituents of the soil solution" is given a convincing account of the toxic substance theory of soil fertility. Any treatment of an organically poisoned soil, which will increase its absorptive properties or its oxidizing power seems to have a beneficial effect upon plants growing therein. The commonly used fertilizer salts are often effective in this way, so that there is nothing in the new theory which might lead one *not* to use the ordinary fertilizers prescribed by the "plant food" theory. This more recent finding of the Bureau of Soils makes the violent and often personal attacks, that have been calculated to hinder the progress of these investigations, appear largely as the mere pommelling of a man of straw.

The book ends with a chapter on the phenomena of alkali soils, dealing with the development of alkali and the theory of its practical handling.—
B. E. LIVINGSTON.

Fossil plants

In the second volume of his *Fossil plants*, Professor SEWARD⁴ continues the work begun over ten years ago and apparently destined to become truly monumental. It is to be hoped that his anticipation of the early appearance of the third volume on the gymnosperms may be realized, and that a fourth hinted at, rather than promised, which is to deal with the angiosperms, may likewise soon be published. The author brings very unusual qualifications to the titanic task of writing a comprehensive textbook of the present condition of our knowledge of fossil plants in both their botanical and geological bearings. He possesses in an unusual degree an acquaintance with the older paleobotany, dealing mainly with the superficial features of plants as seen in impressions, and at the same time is thoroughly in touch with the modern development of the subject, which has put the study of internal structure in the foreground. It is to be regretted that some of the younger investigators of fossil plants are often deplorably ignorant of the older point of view. SEWARD certainly does not err in the direction of the neglect of the older literature or superficial features, which in many cases constitute the only evidence available. Another advantage enjoyed by the author is his unique first-hand knowledge of the material treated. By his travels to various paleobotanically interesting regions and by personal visits to most of the important European collections, he has acquired an intimate acquaintance with fossil plants in their fullest systematic, geological, geographical, and evolutionary bearings possessed by no other living paleobotanist.

The present volume continues the treatment of the Pteridophyta begun in the first, which appeared over ten years ago. In the preface he points out the happy circumstance that recent activity has been chiefly in the field of the present volume, and that as a consequence the first is little out of date. Beginning with a continued discussion of the Sphenophyllales, the writer subscribes a very

⁴ SEWARD, A. C., *Fossil plants*. Vol. II. pp. xxii+624. *figs.* 265. Cambridge: The University Press. 1910.